

Epidemiology of Pediatric Tuberculosis in the United States, 1993–2015

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Surveillance, Epidemiology, and Outbreak Investigations Branch
Division of Tuberculosis Elimination
Centers for Disease Control and Prevention (CDC)

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Pediatric Tuberculosis—Background

- Definition of pediatric tuberculosis (TB): TB disease in a person <15 years old
- In 2015,
 - 9,557 TB cases were reported among all age groups
 - 440 (4.6%) were pediatric
 - 244 (2.55%) in ages 0–4
 - 196 (2.05%) in ages 5–14

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2009 TB Case Definition and Verification

- Incident case of disease
- Case verification categories:
 1. Laboratory confirmed cases:
 - Positive culture or nucleic acid amplification test or
 - Positive Acid-Fast Bacillus smear when culture not attainable
 2. Clinical case definition (all four criteria must be met)
 - Positive tuberculin skin test or positive interferon gamma release assay
 - Signs and symptoms of TB disease
 - Current treatment for TB disease
 - Completed diagnostic evaluation
 3. Provider diagnosis:
 - Diagnosed by health care provider
 - Does not fulfill all criteria necessary to meet laboratory or clinical case definitions

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TB Cases, All Ages, by Age Group, 1993–2015

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<15 years	1660	1659	1536	1356	1251	1077	1038	964	929	944	911	952	851	803	777	786	647	636	578	487	483	458	440
15-24 years	1821	1832	1697	1637	1674	1543	1518	1618	1597	1498	1573	1603	1540	1532	1580	1444	1279	1199	1030	1019	976	962	935
25-44 years	9589	9043	8200	7564	6884	6335	6062	5576	5610	5288	5074	4940	4737	4690	4313	4238	3885	3669	3365	3119	2959	2822	2858
45-64 years	6195	6126	5960	5572	5278	4954	4860	4635	4515	4182	4283	4192	4123	4039	4037	3929	3425	3429	3292	3115	2952	2957	3028
65+ years	5820	5540	5328	5076	4663	4377	4019	3515	3293	3142	2994	2811	2809	2663	2574	2496	2283	2226	2245	2200	2180	2207	2294

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TB Case Rates*, All Ages, by Age Group 1993–2015

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Overall US	9.7	9.3	8.6	8.0	7.4	6.8	6.4	5.8	5.6	5.2	5.1	5.0	4.8	4.6	4.4	4.2	3.8	3.6	3.4	3.2	3.0	2.9	3
<15 years	2.9	2.9	2.7	2.3	2.2	1.9	1.8	1.6	1.5	1.6	1.5	1.6	1.4	1.3	1.3	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.7
15-24 years	5.0	5.1	4.7	4.5	4.6	4.1	4.0	4.1	4.0	3.7	3.8	3.8	3.6	3.6	3.7	3.3	2.9	2.7	2.3	2.3	2.2	2.2	2.1
25-44 years	11.6	10.9	9.8	9.0	8.2	7.6	7.3	6.6	6.6	6.3	6.1	5.9	5.7	5.7	5.2	5.1	4.7	4.5	4.1	3.8	3.5	3.4	3.4
45-64 years	12.5	12.0	11.4	10.4	9.5	8.7	8.2	7.4	7.0	6.3	6.2	5.9	5.6	5.4	5.2	5.0	4.3	4.2	4.0	3.8	3.5	3.5	3.6
65+ years	17.7	16.7	15.8	14.9	13.6	12.7	11.6	10	9.3	8.8	8.3	7.8	7.7	7.2	6.8	6.4	5.8	5.5	5.4	5.1	4.9	4.8	4.8

Note: Rates presented on a logarithmic scale.

* Rates are per 100,000 persons

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Percentage of Pediatric TB Cases by Age Group 1993–2015

N=21,223

	Age < 1 year	Age 1–4 years	Age 5–9 years	Age 10–14 years
Pediatric	10%	49%	22%	19%

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Pediatric TB Cases by Age Group 1993–2015

N=21,223

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Age < 1 year	156	139	118	102	111	103	96	91	97	101	95	81	80	91	115	117	93	76	72	59	67	46	54
Age 1–4 years	858	856	776	668	623	535	506	453	446	455	452	468	394	391	352	380	310	289	279	202	228	217	190
Age 5–9 years	358	395	393	368	305	243	250	222	208	196	195	203	195	159	159	141	140	139	96	109	92	99	88
Age 10–14 years	288	269	249	218	212	196	186	198	178	192	169	200	182	162	151	148	104	132	131	117	96	96	108

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Pediatric TB Case Rates* by Age Groups 1993–2015

N=21,223

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Age < 1 year	4.0	3.6	3.1	2.7	2.9	2.7	2.5	2.4	2.4	2.6	2.4	2.0	2.0	2.3	2.8	2.8	2.3	1.9	1.8	1.5	1.7	1.2	1.4
Age 1–4 years	5.4	5.4	4.9	4.3	4.1	3.5	3.3	3.0	2.9	2.9	2.9	3.0	2.5	2.5	2.2	2.4	1.9	1.8	1.7	1.3	1.4	1.4	1.2
Age 5–9 years	1.9	2.1	2.1	1.9	1.5	1.2	1.3	1.1	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.7	0.7	0.7	0.5	0.5	0.4	0.5	0.4
Age 10–14 years	1.6	1.4	1.3	1.1	1.1	1.0	1.0	1.0	0.8	0.9	0.8	0.9	0.9	0.8	0.7	0.7	0.5	0.6	0.6	0.6	0.5	0.5	0.5

Note: Rates presented on a logarithmic scale.

* Rates are per 100,000 persons

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Pediatric TB Cases by Race/Ethnicity 1993–2015

N=21,223

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
White, non-Hispanic	250	230	185	157	136	137	125	104	87	103	82	76	65	64	70	49	47	46	47	36	46	35	29
Black, non-Hispanic	559	572	517	515	469	372	345	334	310	330	257	289	263	251	225	228	158	177	157	126	125	105	109
Hispanic	639	642	624	512	438	423	432	374	413	401	431	457	396	387	353	357	310	283	255	188	182	188	176
American Indian/ Alaskan Native	22	31	34	37	29	15	15	27	8	13	13	13	12	9	9	10	4	13	12	19	12	4	16
Asian	151	158	146	110	138	97	97	95	94	82	115	103	99	84	104	132	107	93	88	104	100	88	82

Note: Unknown, multiple race/ethnicity, and Native Hawaiian and Other Pacific Islander not shown

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Pediatric TB Case Rates* by Race/Ethnicity 1993–2015

N=21,223

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
White, non-Hispanic	0.7	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Black, non-Hispanic	6.7	6.8	6.1	6.1	5.5	4.4	4.1	3.7	3.4	3.7	2.9	3.3	3.0	2.9	2.6	2.7	1.9	2.1	1.9	1.5	1.5	1.2	1.3
Hispanic	8.4	8.1	7.6	6.0	5.0	4.6	4.6	3.5	3.8	3.5	3.7	3.8	3.2	3.0	2.6	2.6	2.2	2.0	1.7	1.3	1.2	1.2	1.2
Asian	7.6	7.7	6.8	5.0	6.1	4.1	4.0	4.6	4.4	3.7	5.1	4.4	4.1	3.4	4.1	5.1	4.0	3.4	3.2	3.7	3.5	3.0	2.7

Rates presented on a logarithmic scale.

* Rates are per 100,000 persons

Note: Multiple race / ethnicity, American Indian/Alaska Native, and Native Hawaiian and Other Pacific Islander rates not shown because of small denominators

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Pediatric TB Case Rates* among U.S.-born and Foreign-born Children, 1994–2015

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
US Born: Age <1 year	3.3	2.8	2.4	2.7	2.3	2.3	2.1	2.2	2.6	2.6	2.2	1.9	2.1	2.6	2.5	2.1	1.7	1.8	1.4	1.8	1.1	1.3
US Born: Age 1-4 years	4.4	4.1	3.6	3.4	2.9	2.7	2.4	2.3	2.4	2.2	2.3	2.0	2.0	1.8	2.0	1.6	1.5	1.4	1.0	1.2	1.2	1.0
FB: Age <1 year	23.3	106.3	45.1	177.6	43.5	55.7	53.7	69.7	9.3	25.4	9.4	16.2	217.8	32.4	52.8	11.8	26.7	5.6	22.4	16.8	11.3	30.6
FB: Age 1-4 years	61.1	56.6	37.8	38.6	32.3	34.2	28.5	24.8	24.1	34.5	32.5	24.1	21.9	25.3	19.6	17.7	12.4	17.2	18.0	18.7	15.7	10.7

Rates presented on a logarithmic scale. Case data totals beginning in 1994

* Rates are per 100,000 persons

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Pediatric TB Case Rates* among U.S.-born and Foreign-born Children, 1994–2015

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
US Born: Age 5-9 years	1.3	1.4	1.3	1.1	0.9	0.8	0.8	0.6	0.6	0.6	0.7	0.6	0.6	0.5	0.4	0.5	0.5	0.3	0.4	0.3	0.4	0.3
US Born: Age 10-14 years	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3
FB: Age 5-9 years	22.7	22.7	16.6	13.2	9.9	15.3	11.1	15.2	9.8	12.0	10.7	11.2	6.0	9.2	8.1	8.5	7.4	4.5	6.7	5.4	4.5	3.9
FB: Age 10-14 years	14.8	16.0	12.1	10.6	9.2	7.9	8.6	8.6	9.3	7.7	10.8	9.2	7.8	6.9	8.1	4.1	6.5	6.5	6.2	4.3	4.9	5.2

Rates presented on a logarithmic scale. Case data totals beginning in 1994

* Rates are per 100,000 persons

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Number and Percentage of Pediatric TB Cases by U.S. and Foreign Birth, 1993–2015

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Foreign-born	413	386	353	313	287	249	265	255	269	249	268	280	243	200	206	203	143	152	120	135	98	102	95
U.S.-born	1231	1252	1181	1040	960	822	762	707	659	690	643	671	607	603	570	585	504	484	458	351	385	356	344
Percentage foreign-born	24.9	23.3	23.0	23.1	22.9	23.1	25.5	26.5	29.0	26.4	29.4	29.4	28.6	24.9	26.5	25.8	22.1	23.9	20.8	27.7	20.3	22.3	21.6

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Number of Pediatric TB Cases with Foreign Birth by Birth Country*, 1993-2015

N=5,284

1993-2015	
Country	(n)
Mexico	1,722
Philippines	417
Somalia	266
Vietnam	243
Haiti	213
Ethiopia	207
Other	2,216

*Ranked by counts

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Percentage of Pediatric TB Cases with Foreign Birth by Birth Country, 1993 and 2015

1993		2015	
Country	%	Country	%
Mexico	45	Myanmar	11
Philippines	10	Mexico	10
Vietnam	8	Ethiopia	6
Haiti	4	Philippines	6
Somalia	2	Honduras	5
Ethiopia	2	Kenya	5
Other	29	Other	57

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States with the Greatest Percentage of Total Pediatric TB Cases, 1993-2015

N= 21,223

	California	Texas	New York*	Florida	Georgia	Illinois	All Others
Pediatric Percentage (%)	24	13	8	5	4	4	42

*Includes New York City

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States with Greatest Numbers of Pediatric TB Cases, 1993–2015

Pediatric TB Cases			
State	Number	Percent*	Rate**
California	4,998	6.8%	2.8
Texas	2,687	7.1%	2.2
New York	1,691	4.5%	2.0
Florida	1,131	4.6%	1.6
Georgia	950	7.6%	2.2
Illinois	920	6.1%	1.5
All others	8,846	5.9%	1.1
Overall U.S.	21,223	6.0%	1.5

*Average percentage of total state cases that are pediatric, for all years

**Time-averaged annual rate per 100,000

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States with Greatest Percentage of Pediatric TB cases, 1993–2015

State	Number	Percent*	Rate**
Alaska	178	11.9%	5.0
Oklahoma	367	10.5%	2.1
Rhode Island	95	10.0%	2.1
Minnesota	401	9.9%	1.7
Idaho	29	9.2%	0.4
Delaware	64	8.8%	1.7
All others	20,089	5.9%	1.5
Overall U.S.	21,223	6.0%	1.5

*Average percentage of total state cases that are pediatric, for all years

**Time-averaged annual rate per 100,000

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States with Greatest Rate of Pediatric TB Cases, 1993–2015

State	Number	Percent*	Rate**
Alaska	178	11.9%	5.0
D.C.[†]	72	4.1%	3.4
California	4,998	6.8%	2.8
Texas	2,687	7.1%	2.2
Georgia	950	7.6%	2.2
Rhode Island	95	10.0%	2.1
All others	12,243	5.5%	1.2
Overall U.S.	21,223	6.0%	1.5

*Average percentage of total state cases that are pediatric, for all years

**Time-averaged rate per 100,000

†D.C. (District of Columbia) is a distinct reporting jurisdiction

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Pediatric TB Cases by Case Verification Criteria*, 1993–2015

N=21,223

Laboratory Confirmed	Clinical Case	Provider Diagnosis
26%	52%	22%

*Based on the public health surveillance definition for TB [MMWR 1997;46(No. RR-10):40-41]

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Pediatric TB Cases by Case Verification Criteria and Age Group, 1993–2015

N=21,223

Age < 1 year n=2,160

Laboratory Confirmed	Clinical Case	Provider Diagnosis
51%	26%	23%

Age 1–4 years n=10,328

Laboratory Confirmed	Clinical Case	Provider Diagnosis
21%	55%	24%

Age 5–9 years n=4,753

Laboratory Confirmed	Clinical Case	Provider Diagnosis
16%	61%	23%

Age 10–14 years n=3,982

Laboratory Confirmed	Clinical Case	Provider Diagnosis
38%	46%	16%

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Pediatric TB Cases by Site of Disease, 1993–2015

	Pulmonary	Extrapulmonary	Both
Site of Disease	71%	22%	7%

Any extrapulmonary involvement* (totaling 29.5%)	
Lymphatic	18.8%
Meningeal	3.6%
Miliary	1.3%
Bone & Joint	1.5%
Other	4.3%

*Any extrapulmonary involvement which includes cases that are extrapulmonary only and both. Patients may have more than one disease site but are counted in mutually exclusive categories for surveillance purposes.

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Pediatric TB Cases by Site of Disease and Age Group, 1993–2015

N=21,223

Age <1 year n=2,160

	Pulmonary	Extrapulmonary	Both
Site of Disease	76%	10%	14%

Age 1–4 years n=10,328

	Pulmonary	Extrapulmonary	Both
Site of Disease	72%	21%	7%

Age 5–9 years n=4,753

	Pulmonary	Extrapulmonary	Both
Site of Disease	69%	26%	5%

Age 10–14 years n=3,982

	Pulmonary	Extrapulmonary	Both
Site of Disease	66%	28%	6%

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Percentage of TB Cases in Children with Any Extrapulmonary Involvement* by Age Group, 1993–2015

N=21,223

Site of Disease	Age < 1 (n=2,160)	Age 1-4 (n=10,328)	Age 5-9 (n=4,753)	Age 10-14 (n=3,982)
Lymphatic	7.8%	19.2%	22.3%	19.5%
Meningeal	8.4%	4.0%	1.7%	2.1%
Miliary	4.5%	1.1%	0.5%	1.1%
Bone & Joint	0.4%	1.3%	1.8%	2.4%
Other	3.3%	2.6%	4.5%	9.1%
Total	24.4%	28.2%	30.8%	34.2%

*Any extrapulmonary involvement includes: 1.) extrapulmonary only, and 2.) both extrapulmonary and pulmonary.

Note: Combine the total extrapulmonary percentage shown with the pulmonary percentage in slide #23 to obtain 100% for each age group.

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Percentage of TB Cases in Children Age < 1 Year with Any Extrapulmonary Involvement*, 1993–2015
N=2,160

Site of Disease	U.S.-born (n=2,003)	Foreign-born (n=152)
Lymphatic	7.1%	17.7%
Meningeal	8.7%	3.3%
Miliary	4.7%	3.3%
Bone & Joint	0.3%	0.7%
Other	3.3%	3.3%
Total	24.1%	28.3%

*Any extrapulmonary involvement includes: 1.) extrapulmonary only, and 2.) both extrapulmonary and pulmonary.

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Percentage of TB Cases in Children Age 1–4 Years with Any Extrapulmonary Involvement*, 1993–2015
N=10,328

Site of Disease	U.S.-born (n=8,603)	Foreign-born (n=1,684)
Lymphatic	19.3%	18.8%
Meningeal	4.4%	2.0%
Miliary	1.1%	0.9%
Bone & Joint	1.2%	2.2%
Other	2.7%	1.9%
Total	28.7%	25.8%

*Any extrapulmonary involvement includes: 1.) extrapulmonary only, and 2.) both extrapulmonary and pulmonary.

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Percentage of TB Cases in Children Age 5–9 Years with Any Extrapulmonary Involvement*, 1993–2015
N=4,753

Site of Disease	U.S.-born (n=3,151)	Foreign-born (n=1,582)
Lymphatic	23.6%	19.8%
Meningeal	2.0%	1.1%
Miliary	0.5%	0.6%
Bone & Joint	1.4%	2.5%
Other	4.7%	4.1%
Total	32.2%	28.1%

*Any extrapulmonary involvement includes: 1.) extrapulmonary only, and 2.) both extrapulmonary and pulmonary.

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Percentage of TB Cases in Children Age 10–14 Years with Any Extrapulmonary Involvement*, 1993–2015
N=3,982

Site of Disease	U.S.-born (n=2,106)	Foreign-born (n=1,876)
Lymphatic	20.5%	18.4%
Meningeal	2.2%	2.0%
Miliary	1.4%	0.8%
Bone & Joint	2.1%	2.7%
Other	10.2%	7.7%
Total	36.4%	31.6%

*Any extrapulmonary involvement includes: 1.) extrapulmonary only, and 2.) both extrapulmonary and pulmonary.

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Pediatric TB Cases by HIV Status, 1993–2014*
N=20,783

- Information on HIV result is not available for the majority of pediatric TB cases (73.3%)
- Pediatric cases with HIV-positive test results of those patients with known results (3.3%)

*California HIV data missing from 2005 – 2010; Vermont HIV data through 2006 only.

Note: Through 2004, California only reported positive HIV test results based on TB and AIDS registry matching; all other California TB cases were classified as “Unknown.”

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Number and Percentage of Culture-Confirmed Pediatric TB Cases with Drug Resistance, 1993–2014

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Resistance to any 1st line drug	31	43	31	38	38	28	28	27	38	33	31	40	38	27	24	44	32	22	18	22	30	20
Percentage with resistance to any 1st line drug	9.7	13.3	10.3	12.7	13.4	12.2	12.3	11.3	15.0	14.7	14.8	17.4	18.2	13.3	11.3	21.4	19.4	13.8	11.7	15.8	18.0	17.4
MDR TB	6	6	4	6	4	6	5	1	3	4	3	1	5	4	4	5	3	2	3	3	2	1
Percent with MDR TB	1.9	1.9	1.3	2.0	1.4	2.6	2.2	0.4	1.2	1.8	1.4	0.4	2.4	2.0	1.9	2.4	1.8	1.3	1.9	2.2	1.2	0.9

First line drugs are Isoniazid, Rifampin, Pyrazinamide and Ethambutol

MDR TB = resistance to at least Isoniazid and Rifampin

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Percentage of Pediatric TB Cases by Use of Directly Observed Therapy (DOT), 1993–2013

N=20,256*

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
DOT only	22.1	26.9	41.0	47.4	55.5	58.3	56.6	61.8	61.9	64.5	63.5	65.8	64.6	65.2	63.7	68.2	66.5	65.2	67.2	68.1	67.1
Self-Administered only	64.3	51.0	34.5	28.2	20.1	17.1	15.1	13.4	11.3	7.6	6.3	6.3	6.6	4.7	4.0	3.4	4.8	5.0	2.4	3.9	4.0
DOT and Self-Administered	12.1	19.1	22.3	22.1	22.5	23.4	26.0	23.9	26.0	26.3	29.3	25.7	27.9	30.1	32.0	27.0	28.1	29.4	28.9	27.4	27.0

*Pediatric TB cases with patient alive at diagnosis and started on treatment

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Pediatric TB Cases by Treatment Outcome 1993–2013

N=20,256*

Outcome	Cases	%
Completed treatment	19,368	95.6
Moved	396	2.0
Lost to follow-up	162	0.8
Died	105	0.5
Other**	225	1.1

Note: Cause of death not recorded in TB case reports until 2009; “Moved” no longer a valid response

*Pediatric TB cases with patient alive at diagnosis and started on treatment

**Other includes refused, other, unknown, adverse drug reaction, and missing

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Deaths Occurring Among Pediatric TB Cases, by Age Group, 1993–2013

N=20,325*

Age Group	Cases	Deaths**	% of Cases
Age<1 year	2,060	40	1.9
Age 1–4 years	9,921	65	0.7
Age 5–9 years	4,566	28	0.6
Age 10–14 years	3,778	24	0.6

Note: Cause of death not recorded in TB case reports until 2009; “Moved” no longer a valid response

*Pediatric TB cases with patient alive at diagnosis and started on treatment

**Death total are cases dead at diagnosis and died during therapy